

AD-A081 365

RAND CORP SANTA MONICA CA
MANAGING SHOP WORKLOADS.(U)
FEB 62 T C SMITH
RAND/RM-3003-PR

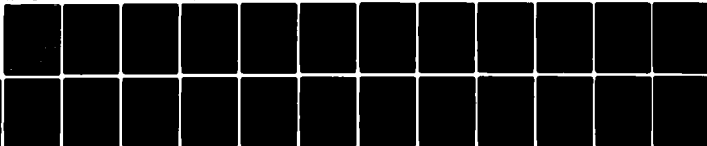
F/8 15/7

UNCLASSIFIED

AF 49(638)-700

NL

[OF]
AGE
4/24/80



END
DATE
FILMED
4-80
DTIC

LEVEL #

MEMORANDUM
RM-3003 PR
FEBRUARY 1968

ADA 081 365

MANAGING SHOP WORKLOADS

P. C. Smith

OFFICIAL FILE COPY

NAME Mc OA
Index of Record

DTIC
ELECTE
MAR 3 1968

DISTRIBUTION STATEMENT A
Approved for public release
Distribution Unlimited

PREPARED FOR:

UNITED STATES AIR FORCE PROJECT RAND

RAND

SANTA MONICA • CALIFORNIA

79 11 05 114

DEC FILE COPY

9 MEMORANDUM *rept.*

RM-3003-PR

11 FEBRUARY 1962

14

13

MANAGING SHOP WORKLOADS

T. C. Smith

SPECIAL FILE COPY

NAME M.C.R.R.
Office of Record

15
This research is sponsored by the United States Air Force under Project RAND - Contract No. AF 19(638)-700 - monitored by the Directorate of Development Planning, Deputy Chief of Staff, Research and Technology, Hq USAF. Views or conclusions contained in this Memorandum should not be interpreted as representing the official opinion or policy of the United States Air Force. Permission to quote from or reproduce portions of this Memorandum must be obtained from the RAND Corporation.

Acc. *Little on file*

DISTRIBUTION STATEMENT A
Approved for public release
Distribution Unlimited

The RAND Corporation
1700 MAIN ST • SANTA MONICA • CALIFORNIA

A

2100

PREFACE

This Memorandum outlines a tentative system for managing repair-shop workloads at an Air Force base. It summarizes the suggestions that C. F. Bell, W. W. Haythorn, O. T. Gatto, and the author have formulated in a survey of maintenance-management activities at Oxnard Air Force Base. These ideas comprise only a part of a broader research project suggested by the Directorate of Maintenance Engineering, Hq USAF, which would further develop and improve the maintenance-management system established by Air Force Manual 66-1 and related directives. Future documents will treat other phases of the project as research is completed.

The purpose of this Memorandum is to provide a documented basis for discussing the suggested workload management system in terms of Oxnard operations and conditions. It contains no final proposals or recommendations; however, it is hoped that the suggested system will be applicable to Air Force bases in general.

If discussions with Oxnard management demonstrate system feasibility, its usefulness for managing the shop workload at larger bases in other commands will be explored. Finally, if these discussions are successful and the system as modified by experience at Oxnard and other bases proves useful in a general Air Force context, a revised and expanded version of the Memorandum will be prepared for general distribution.

Pending successful completion of these steps, however, the present version of the Memorandum will be distributed only to selected management personnel at Oxnard and other Air Force bases, for review and discussion. Air Force staff offices and other interested management agencies should regard it only as a progress report subject to considerable modification and further development.

SUMMARY

Air Force emphasis on base self-sufficiency makes the control of base-shop workloads an important responsibility of maintenance management. Air Force Manual 66-1, Organizational and Field Maintenance, assigns this responsibility to workload control in the maintenance control complex and the field maintenance activity on each base. It also provides for the collection of much information, some of which is useful for managing shop workloads, but it does not provide specific policy direction and detailed procedures for exercising the authority identified with shop workload control responsibilities.

The purpose of this Memorandum is to suggest a system based on AFM 66-1 philosophy which should help Oxnard Air Force Base fill in some of these details. The Memorandum outlines procedures for summarizing, monitoring, and controlling the flow of work through all base repair shops or work centers so as to maximize shop support of both mission-oriented requirements and the base master-repair program.

The system assumes that Oxnard management follows policies outlined in AFM 66-1 which dictate that all flight-line requirements are to be met first and other requirements last. The system is also based on the assumption that AFM 66-1 policy recognizes and establishes the need for centralized cognizance and control over the total workload of each shop. The suggestions in this Memorandum would implement this concept by establishing an office or position to be known as the Shop Workload Manager.

The system provides the Shop Workload Manager with a preliminary set of control policies and procedures, together with supporting documents and information, for exercising his centralized control responsibilities. The

supporting documents furnish him a running record of the average maintenance manpower available for shop repairs and the average workload generated daily by the base for each shop. The suggested procedures provide him a system for documenting, activating, and controlling all shop repair backlogs. The suggested policies give him a simple measure and rule for controlling the normal flow of work through all base repair shops and for recognizing unusual circumstances requiring special management attention and direction.

Although the system centralizes cognizance over base-wide maintenance requirements affecting all base shops, it does not give the Shop Workload Manager command and supervisory control over Shop Supervisors. Specialist work assignments and shop productivity remain the responsibility of Shop Supervisors. Similarly, flight-line dispatch requirements, assignments, and productivity remain the responsibility of Maintenance Control and the flight-line organization under the supervision of the Chief of Maintenance and the Commander. The suggested system provides the Shop Workload Manager only with policy guidance and supporting information for scheduling and controlling the gross flow of work through base repair shops. Therefore, it is a workload management tool rather than a shop productivity or personnel management tool.

CONTENTS

PREFACE	iii
SUMMARY	v
Section	
I. INTRODUCTION	1
II. INFORMATION REQUIREMENTS	9
Definition and Explanation of Column Entries in the Shop Personnel Availability Record	9
Definition and Explanation of Column Entries in the Shop Workload Record	13
III. PENDING WORKLOAD	19
IV. BACKLOG MEASUREMENT AND CONTROL	23
V. CONCLUSIONS	27

I. INTRODUCTION

Air Force emphasis on base self-sufficiency and maximum use of field-maintenance shop-repair capabilities makes control of base-shop workloads an important maintenance responsibility.* Air Force Manual 66-1 assigns this responsibility jointly to workload control in the maintenance control complex and to the field maintenance activity.** It also provides for the collection of much information, some of which is essential for managing shop workloads. However, it does not provide specific policy and detailed procedures for exercising the authority identified with shop workload control responsibilities.

The purpose of this Memorandum is to help Oxnard Air Force Base fill in some of these details. It outlines a system for coordinating, managing, and controlling shop workloads and backlogs to maximize shop support of both priority mission requirements and the base master-repair program. The proposed system incorporates a simplified version of AFM 66-1 priority policy.*** It suggests implementation of additional control procedures and supporting documents. It also identifies the required information and management records.

The system is based on the assumption that Oxnard maintenance management follows maintenance operating policies or management philosophy outlined in AFM 66-1, which we have condensed for our purposes as follows:

* Air Force Manual 66-1, Organizational and Field Maintenance, July 1, 1961, Chap. 2, Par. 56 and Chap. 14, Par. 19; Air Force Regulation 66-1, September 5, 1961, Par. 2c; and Air Force Regulation 66-7, March 18, 1960, Par. 1.

** AFM 66-1, Chap. 2, Par. 5, pp. 2-1 and 2-2; and Par. 26, pp. 2-6 and 2-7.

*** AFM 66-1, Chap. 2, Par. 22, pp. 2-5 and 2-6.

1. Shop support will be furnished flight-line, mission-oriented, aircraft on a priority basis:
 - to meet alert requirements,
 - to accomplish scheduled flying-training missions, and
 - to maximize operational readiness time.
2. Shop support will be furnished periodic and other inspections, TOC's, etc., after flight-line priority requirements have been satisfied.
3. Shop support will be given last to the manufacture, adjustment, and repair of items included in pre-issue stocks, listed on master repair schedules, or generated by similar supply stock-age requirements.

The system further assumes that effective management of base-shop workloads requires that current knowledge on availability of resources (people, parts, and equipment) and of total workload requirements (alert and flying schedules, outstanding TOC's, supply repair schedules, etc.) be centralized in one activity, office or function.* We therefore suggest that Oxnard Air Force Base designate a "Shop Workload Manager" who should have the responsibility and authority, together with the required data, for controlling the flow of work into all base shops and for controlling all shop backlogs.** We further suggest that this should be the primary

*For our purposes, "current" knowledge means at least day-to-day cognizance over both personnel (specialist) availability and workload requirements. "Availability," in turn, refers to specialists actually on duty in a shop who are either at work or available (but waiting) for work, rather than to those who might be assigned or authorized to a shop.

**Although he measures flight-line workloads, he does not control flight-line dispatches and work assignments.

duty of the Shop Workload Manager, that he should have a rank commensurate with his authority and responsibility, and that his duties, responsibilities, and authority should be clearly outlined in an appropriate directive.

Granted these assumptions and understandings, the Shop Workload Manager's objective is simple: He will control the total base-wide backlog for each specialist category or shop (this might be an aggregation of work centers) to encourage maximum use of shop repair capability remaining after all flight-line (priority) demands for specialist support have been satisfied. He does not control flight-line work but he must have data which accurately measure such demands for specialist support so that he can plan, schedule, and control all other workloads so as to use all remaining support capability.*

Such an objective requires the following information:

1. Personnel information (shop by shop).
 - a. Total number of specialists assigned to the shop. This information should be reflected on the Master Roster Listing as amended by changes submitted during the month.**
 - b. Total number of specialists available for work each day.*** Normally, this will be the total number assigned less the number lost to sickness, leave, etc., as explained below.

*For similar statements of workload scheduling and control objectives, see AFM 66-1, Chap. 2, Par. 102, p. 2-3, and Chap. 14, Par. 19, p. 14-4.

**Chap. 8, Pars. 24-27, 34, and 37, pp. 8-9, 8-10, and 8-13.

***Specialists who might be "assigned" flight-line work only would also be included. In other words, "total number of specialists" means all of them, regardless of how the shop supervisor might assign them to work.

- c. Total number of specialists not available for work each day. It should be noted that this category includes all specialists' time which cannot be used to accomplish maintenance tasks. The Shop Workload Manager is responsible for neither the availability nor the non-availability of these people. We assume that management and control of specialists' time siphoned off into other activities is a command function and that the responsibility remains with the Shop Supervisor, the Chief of Maintenance, and the Commander. We also assume that personnel requirements are not a responsibility of the Shop Workload Manager even though his records will provide important inputs for estimating maintenance manpower requirements.

2. Workload information (shop by shop).

- a. Active work orders, however identified, including the following specific data on estimated and actual man-hours.

- (1) Total estimated outstanding or beginning requirements.
- (2) Total estimated man-hours added each day.
- (3) Total estimated and actual man-hours completed each day.
- (4) Total estimated backlog remaining each day.

It should be noted that we are concerned with gross backlog only. We are not attempting to determine the daily status (percentage completed) of individual work orders. These remain the prerogative and

responsibility of the Shop Supervisor and other elements of the Maintenance Control complex.*

b. Pending or unassigned workload (shop by shop), including the following categories.

- (1) Total estimated (man-hours) workload awaiting parts, special equipment, or instructions, including work-orders which might be unassigned because of an excessive backlog in the shop.
- (2) Known TOC or other requirements that are not yet due or that should be activated on a specific date.
- (3) All other known, non-critical jobs that have not been assigned work-order numbers or approved for work and could be postponed for a long time.

Alternative policies for controlling the flow of workload from the pending to active categories are as follows.

1. Constant-level Backlog Policy: This is a policy of keeping a constant 3-day, 5-day, 10-day, or similar level of backlog scheduled into each shop at all times.** This policy requires accurate knowledge of the long-run availability of specialist manpower and the manpower actually used on the average to support priority flight-line demands. Given these data, the Shop Workload Manager can plan for and assign work to absorb

*See AFM 66-1, Chap. 2, Pars. 35, 36, and 37, pp. 2-8 and 2-9.

**AFM 66-1, Chap. 14, Par. 19, p. 14-4, suggests use of a 10-day level.

the remaining average capability of the shop.* Once established, a constant-level backlog is impartial and easily administered. The Manager watches the total estimated backlog remaining each day and assigns sufficient work to maintain the level established by policy. Although such a policy is easy to administer, it does not solve the problem of which work order to activate from the pending file, how to choose between competing work orders when the shop is already loaded to capacity, or how to meet changing priorities for work already in progress. At this time, we assume these problems are exceptions rather than normal, day-to-day requirements; therefore, we suggest that they be decided as they occur on the basis of routine priorities established in AFM 66-1 or after coordination among the Shop Workload Manager, the Shop Supervisor, and, if required, the Chief of Maintenance to get action on priority changes, personnel reassignments, etc.

2. Opportunistic Backlog Assignment Policy: This policy requires the Manager to feed work into the active backlog on a random, perhaps even hourly, basis to absorb fluctuations in shop repair capability. It requires rather precise knowledge of the current, at least shift-by-shift, availability of manpower in each shop and the current status (percentage completed) of all work in progress. Because it invades the responsibility of the Shop Supervisor to control work in progress and greatly

*Assuming there is enough "pending" workload to absorb the shop's capability.

increases the data required for activating all work orders, we suggest that this policy be used only to meet unusual circumstances. It should be used to meet emergency situations which require review and reshuffling of priorities already assigned to work orders. It also could be used to insure (or regain) control in shops managed by untrained or weak supervisors.

II. INFORMATION REQUIREMENTS

Information needed to administer the suggested system may be kept on two separate forms, the Shop Personnel Availability Record and the Shop Workload Record (Figs. 1 and 2). In addition, unassigned or pending workloads should be systematically identified and controlled through a central file. Suggested formats, data description and related explanations follow.

DEFINITION AND EXPLANATION OF COLUMN ENTRIES IN THE SHOP PERSONNEL AVAILABILITY RECORD

<u>Column Number</u>	<u>Definition and Explanation</u>
1	<u>Date</u> : Depending on the period covered by the record, this column would reflect either the conventional day-month-year sequence or consecutively numbered day-of-the-year entries.
2	<u>Total number of personnel assigned today</u> refers to the total number of airmen assigned to duty in this shop on official organizational records such as the Monthly Master Roster Listing as amended by changes submitted during the month.
3	<u>Total number of man-hours assigned today</u> is a straightforward computation of the number of personnel assigned duty in the shop times the length of the workday, which might vary from 4 (Saturday) to 12 (alert exercise) hours.
4	<u>Total number of personnel not available today</u> refers to those men assigned to the shop for duty whose time is actually diverted wholly or in part to supervision, administrative, and related activities (Codes 03-17) or who are absent (Codes 30-46). It should be noted that this entry is for information purposes only. The Shop Workload Manager is <u>not</u> responsible for monitoring or controlling training,

	1	2	3	4	5	6	7	8	9	10	11	12
Day of Month												
	Today				Cumulative Totals				Daily			
	Assigned		Not Available		Available		Assg'd.	Manhours Not Available		Available	Work	Average
	No.	Mhrs.	No.	Mhrs.	No.	Mhrs.	Manhours	Manhours	Available	Manhours	Days	Manhours Available
	(Amounts Brought Forward)											
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30*												
31												
	(Amounts Carried Forward)											

* Although a month is shown, the period covered might be a quarter or more.

leave, time-off, administrative, or overhead uses of shop personnel. Supervision, management, and control of these diversions and absences remain the responsibility of the Commander, the Chief of Maintenance, and the Shop Supervisor. It is felt they are adequately recorded for control under existing AFM 66-1 provisions.

- 5 Total number of man-hours not available is computed as outlined in 3 above.
- 6 Total number of personnel available today refers to the number available for duty (included in the shop roll call) who are actually available for flight-line dispatch and base-shop repair tasks. The number excludes all airmen reported in the non-available categories identified above. It includes all airmen carried in Codes 01, 01.1, 02, 18, and 20-24. Codes 01 and 01.1 are self-explanatory; the men are available for work whether busy or not. Code 02, alert time, is included for two reasons. Bona fide alert duty is a genuine support requirement or "maintenance task;" hence, airmen assigned such duty should be included in the total available manpower. In addition, such personnel often perform minor repair or inspection tasks, especially on the alert weapons, while on alert. Although the availability of alert crews for doing "shop" maintenance depends on both the specific nature of their alert duty and local circumstances involving distances, facilities, etc., it is suggested that their "bonus" capability to perform some kinds of maintenance tasks should not be overlooked. Code 18 is included because travel time is part of the total job whether measured in seconds or minutes. Codes 20-24 are included because they also represent manpower (repair and inspection capability) which was

available even though it was lost for the different reasons identified by the lag codes.

- 7 Total available man-hours today is computed as indicated in 3 above; however, caution must be exercised to assure that adjustments are made to include increases or decreases in the hours reported resulting from personnel being available only part of the day.

Columns 8 through 12 show three types of cumulative totals or averages: the monthly total amounts brought forward into the current month from each of the two previous months; the cumulative total as of the given day of the month; and the monthly total of "amounts carried forward" to the next month at the end of the month.

The entries in Columns 8 through 11 are used to compute a moving or running daily average of available man-hours shown in Column 12. As will be noted, this average incorporates data from at least two and at most three months of shop experience. It should be pointed out that the Shop Personnel Availability Record can be used to incorporate shop experience for periods either shorter or longer than a quarter. For example, the "amounts brought forward" could be totals for the last two weeks of the preceding month. This procedure would produce averages based on two to six weeks of shop experience. Any period chosen will be somewhat arbitrary, but the choice should be guided by the purpose of the system: to provide the Shop Workload Manager a useful estimate of the daily average number of available man-hours for workload planning and scheduling. The period should be long enough to be meaningful; that is, it should be more useful than a three-day average, which might be distorted by wide daily fluctuations. On the other hand, it should be short enough to reflect current variations and reveal trends.

- 8 Total cumulative assigned man-hours is the cumulative total of the amounts brought forward and all entries in Column 3 for the period.
- 9 Total cumulative man-hours not available in the shop is the cumulative total of the amounts brought forward and all entries in Column 5 for the period.
- 10 Total cumulative available man-hours is the cumulative total of the amounts brought forward and all entries in Column 7 for the period.
- 11 Cumulative number of work days for the period is the total number of workdays to date or for the month or period used. However, if Saturday or Sunday work-schedules for a shop do not represent a full day's activity, such days should be given appropriate weight in the count of total days for averaging purposes. For example, treat two half-days as only one day in computing the average to date, or for a month or other period.
- 12 Daily average number of man-hours available in the shop is the mean of the corresponding entry in Column 10 computed as follows:

$$\frac{\text{Column 10}}{\text{Column 11}} = \text{Column 12.}$$

DEFINITION AND EXPLANATION OF COLUMN ENTRIES IN THE SHOP WORKLOAD RECORD

<u>Column</u>	<u>Description and Explanation</u>
1	<u>Date:</u> See explanation for Shop Personnel Availability Record.
2	<u>Beginning estimated total man-hours:</u> Initially, this is the estimated total workload outstanding at the beginning of the period. It would be determined by a "one-time" inventory of all outstanding, active work orders or other records representing work in progress in the shop. Subsequent entries would be the amounts brought forward from

Fig. 2 -- SHOP WORKLOAD RECORD

1 Day of Month	2 Estimated Workload (Manhours)		3 New Total Today		4 Cumulative Total		5 Estimated Today		6 Actual Today		7 Cumulative Totals Estimated Actual		8 Completed Workload (Manhours)*		9 Total Today		10 Adjusted Total		11 Shop Days	
	Beginning Total																			
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				
13																				
14																				
15																				
16																				
17																				
18																				
19																				
20																				
21																				
22																				
23																				
24																				
25																				
26																				
27																				
28																				
29																				
30																				
31																				

*Workorders, specialist dispatch records, etc., however identified, but which represent completed repair, inspection or other maintenance jobs.

previous months or weeks^{*} and from each previous day from Column 4. At no time would this entry include "anticipated" workload identified for numbering and coding convenience on "annual" work orders. All such requirements would be held in the "pending workload" file until actually activated by appropriate work authorization documents or records such as AF Forms 48, 344, and 992, and AFTO Forms 210, 211, or 212.

- 3 New total estimated man-hours today tabulates the estimated manhours of workload generated and activated today. It includes all work generated on the flight line, bench check requirements, new work orders activated today, TOC's that fall due, and all master repair items actually scheduled into the shop. The work generated on the flight line will include all dispatches originating in Maintenance Control (teleautograph records) whether or not completed today. In other words, all work for which the shop would be responsible wherever generated on the base would be brought together and included in this total. Although not thus specified at this time, we realize that this aggregation requires that supplementary back-up files or records be kept for each shop on a chronological (daily) basis.
4. Cumulative total estimated man-hours is the sum of Columns 2 and 3 for each day. This entry is carried forward to Column 2 for the following day. Depending on the period chosen, all or part of it is also carried forward at the end of the month to the next month's record.

^{*}See discussion concerning Shop Personnel Availability Record entries for remarks on choice of period.

- 5 Estimated workload completed today is the sum of the estimated (original or revised)* man-hours of work on all work orders, dispatches, etc., actually closed out today. This represents not only work started and completed today (specialist dispatches to flight line) but also work orders, dispatches, etc., completed (closed out) today which might have been started on an earlier date.
- 6 Actual workload (man-hours) completed today is the sum of all man-hours actually charged to all work orders, dispatches, etc., (closed out) today. Actual man-hours might be more or less than the number estimated for any given work order. Complete agreement between "estimated" and "actual" entries should be the exception rather than the rule.
- 7 Cumulative total estimated workload completed is the sum of amounts brought forward and all entries in Column 5 for the period.
- 8 Cumulative total actual workload completed is the sum of amounts brought forward and all entries in Column 6 for the period.
- 9 Total estimated backlog today is the difference between Column 4, cumulative estimated total man-hours, and Column 7, cumulative total completed.
- 10 Adjusted total backlog is the amount shown in Column 9, total estimated today, adjusted to reflect the cumulative experience of the shop for correctly estimating the work on individual work orders. It is equal to the amount shown in Column 9 times the ratio of Column 8 to Column 7.

$$\text{Column 10} = \text{Column 9} \times \frac{\text{Column 8}}{\text{Column 7}}$$

*Revision may result from review and evaluation of work orders as discussed in Sec. IV, "Backlog Measurement and Control."

If estimates tend to exceed actual figures, the estimated backlog will be adjusted downward according to cumulative experience. Conversely, if they are less than actual the estimated backlog will be adjusted upward. Ideally, the ratio should average 1.0, and variations about 1.0 should represent a normal curve.

- 11 Estimated shop-days of backlog is equal to the total adjusted backlog (Column 10) divided by the daily average number of available man-hours (Column 12) of the Shop Personnel Availability Record. This is the key entry reviewed daily for making decisions on activation of "pending work orders." In general, it should agree with the 3-day, 5-day, or 10-day, or x-day level established by policy after activating an appropriate amount of pending workload.*

* AFM 66-1, Chap. 14, Par. 19, p. 14-4, suggests that a 10-day backlog of work is a "yardstick" which can be used for shop-loading purposes.

III. PENDING WORKLOAD

The "pending workload" file would include workload information ranging from regular work orders that have been suspended temporarily for lack of parts, to preliminary instructions or informal memoranda on non-critical adjustments, or minor modifications which could be postponed for a very long time without serious consequences. As already indicated, we suggest that this "pool" of pending workload for each shop be divided into at least three different categories for control purposes.

The first category would include work orders which, in the opinion of the Shop Workload Manager, should not be assigned to a shop because of its excessive backlog, and those which must be suspended temporarily for lack of parts, equipment, or further instructions. Although such work orders represent firm workload requirements, they should be withheld or removed from the active files. The rationale for withholding those in excess of backlog policy levels would be to avoid frustrating the Shop Supervisor until special arrangements could be made for their completion. Temporarily suspended work orders would be withdrawn because they no longer represent current backlog in the shop. Normally, elimination of the delays associated with suspended work orders is beyond the scope and authority of the Shop Supervisor; therefore, he should be relieved from all responsibility for them until they are reactivated. His primary responsibility is to assure effective repair and inspections rather than to hustle paperwork, parts, and equipment. Until the Shop Workload Manager and Materiel Control* fulfill their joint responsibility for assembling all the required parts, equipment

*AFM 66-1, Chap. 2, Pars. 24 and 26, pp. 2-6, and Pars. 48 through 54, pp. 2-16 and 2-17; Chap. 3, Pars. 3, 32, 33, 34, et seq.

and information or instructions, that is, do their job of providing manage-
ment support, the Shop Supervisor should not be concerned with the temporar-
ily suspended workload.*

The second category of pending work would include firm requirements which have not yet been activated. Three examples are: (a) TOC actions or modifications not yet due, (b) tasks or jobs recorded on AFTO Forms 781B, 45 or similar documents which have been "carried forward" or postponed for short periods of time, and (c) Hi-Valu or other items which must be repaired or processed within a specified period of time. In other words, we would systematically identify and record under this category all items of pending work which could be assigned a specific due-date for automatic activation.

The last category would include all non-critical workloads which could be used as "filler" jobs or work during slack periods.** This category would include a range of "requirements" extending from items carried forward on the 781B or related documents reflecting non-critical tasks postponed more or less indefinitely, to the local manufacture of items for the good and welfare of the base. It is important to note that all requirements not obviously non-critical would be excluded from this category. The rule should be that if the job cannot be postponed indefinitely, assign it a due-date under category 2 above and activate it accordingly on a work order or other work-authorization document.

*Suspensions may range from one minute to an indefinite period of time. Since policy must be set at some duration to be meaningful, we suggest that any estimated delay of more than 48 hours be deemed sufficient reason for removing a work order from the active file.

** See AFM 66-1, Chap. 2, Par. 34, pp. 2-8.

Normally, non-critical filler work would be activated whenever the shop's backlog dropped below the prescribed 3-day or other level established by base policy. However, in order to prevent indefinite accumulation of such workloads, the "filler" file should be reviewed at least once each week to insure periodic reconsideration of the non-critical status of each item or task carried in the category.

The pending-workload file would include several different kinds of documents such as work orders, TOC's, and TWX's. It also would include informal requests, notes, and extractions from other documents. Regardless of their format, workload documents included in the first two categories would be filed by shop (use duplicate copies and cross references where more than one shop is involved) and by tentative activation date, which in this context means either the estimated date of receipt of parts, equipment, or further instructions (suspended work orders) or the due-date (TOC's, etc.). Work requests, notes, memoranda, and other information falling into the last category -- filler material -- would be filed by shop under a "no date" status.

IV. BACKLOG MEASUREMENT AND CONTROL

Backlog estimates probably range from wild guesses to careful calculations of the man-hours and time required to process each open work order. Obviously, Shop Supervisors cannot be expected to make perfect estimates for all work orders. But it is just as obvious that wild guesses and careless estimates will cause workload control personnel to disregard or discount the estimated workloads reported by Shop Supervisors.* At best, careless estimates and consequent discounting lead to "negotiated" backlogs; at worst, they lead to mistrust and continual bickering between Shop Supervisors and workload control personnel. Prolonged carelessness and discounting will destroy the effectiveness of almost any backlog control program.

There are three ways to avoid the consequences of careless estimates and ad hoc discounting, and at the same time avoid making a fetish out of agreement between estimated and actual man-hours: First, workload management policy should recognize the fact that the numbers will not agree most of the time. Second, the relationship should be measured and reported to avoid disagreement over the facts. Third, the resulting factor or relationship should be used in a fair and equitable manner to control the flow of work into the shop.

We recommend that the relationship be measured as a percentage ratio of the man-hours actually charged to completed work orders or other work documents to the man-hours estimated when the documents were initiated. We suggest that the factor be computed so as to take advantage of the cumulative experience of the shop; therefore, the ratio would be continually

*We take for granted that complete "activation" of a work order includes a routine requiring affected Shop Supervisors to estimate the man-hours and time required to complete the work. See AFM 66-1, Chap. 2, Par. 72a, pp. 2-30.

updated by being calculated from the cumulative totals shown in the Shop Workload Record. As already indicated, this factor would be used to evaluate and adjust the estimated backlog of each shop every day or as often as there is need for making decisions concerning shop workloads and capabilities.

Several benefits should accrue from computation and use of the factor. First, it provides an incentive for Shop Supervisors to make reasonably accurate estimates when work orders (or other work-authorization documents) are activated. In other words, Shop Supervisors know in advance that their initial estimates will be compared with their actual records and that in the long run the comparison will be used to discount or adjust their estimates of future workloads and backlogs. Second, the system provides an actual and recorded discount or adjustment factor for use of the Shop Workload Manager and thus avoids his resort to memory and opinion. Third, the factor is fair to the shop because it is dictated by actual experience.

Although the proposed system is fair to the shop, it is not "cheating proof." It neither eliminates the possibility of a Shop Supervisor attempting to make actual records agree with his original estimates nor prevents him from padding the "actual" man-hours expended on work orders in order to appear busy, overworked, or overloaded with a large backlog. Obviously, he can either pad the actual man-hours reported or report a reduced number of available personnel, or both, and thus manipulate the apparent backlog to his advantage for a time.*

Despite these apparent shortcomings, the system discourages flagrant padding or manipulation of records. For example, if the backlog is maintained

*Periodic, unannounced "backlog inventories," however, should discourage such practices.

at any given policy level, the Shop Supervisor will have to be careful with "liberal" estimates and reported man-hours or he may get caught reporting more man-hours than he had available. Since such a development would be reflected in a comparison of the cumulative totals (Columns 7 and 8) reported in the Shop Workload Record, with the cumulated total of available man-hours (Column 10) on the Personnel Availability Record, he would have some difficulty padding beyond the limit of cumulative available man-hours.

Obviously, the system assumes that Shop Supervisors will make reasonable estimates and report actual results. The system also assumes that the percentage ratio of estimated and actual man-hours will tend to average 1.0 in the long run. In the short run, however, unusual discrepancies will occur and the system should provide routines for identifying and disposing of them.

In general, we would expect to find as many cumulative daily percentage-ratio readings below 1.0 as above. Imbalance in either direction indicates something has gone wrong or needs explaining by the Shop Supervisor and the Shop Workload Manager. A reasonable control limit would be to start asking the Shop Supervisor questions when as many as 65 per cent of the daily percentage-ratios for the period* are either more or less than 1.0. Undoubtedly, the resulting review will uncover individual work orders or work-authorization documents which show substantial differences between initial estimates and actual reported man-hours. Review of the "extenuating circumstances" explaining such differences should be beneficial on two counts. An understanding of the unusual circumstances should help avoid some of

*The "period" should include not less than 30 daily readings.

them in the future. In other cases, their identification probably will lead to revision* of the conflicting records where they warrant change. In both cases, the value of the cumulative totals as correct reflections of average shop workloads and backlogs should improve considerably as unusual discrepancies are uncovered and either corrected or avoided.

*Such revisions would be reflected as adjustments in the affected columns of the Shop Workload Record.

V. CONCLUSIONS

Air Force emphasis on base self-sufficiency and maximum use of field-maintenance shop-repair capabilities increases the importance of effective control over base-shop workloads. AFM 66-1 identifies this maintenance management responsibility with two activities: workload control in the maintenance control complex, and the field maintenance organization. The manual does not provide management in these activities with detailed policies and procedures for carrying out the related management responsibilities.

The purpose of this Memorandum has been to provide some of these details for use at Oxnard Air Force Base, outlining a tentative system for recording, monitoring, and controlling the gross flow of work in and out of base repair shops and centers so as to maximize shop support capabilities. It assumes Oxnard adherence to the AFM 66-1 priority system for assuring that all flight-line requirements are satisfied first. Consistent with the policy concept of centralized management of base maintenance activities, it would implement cognizance and control of shop workloads through one office or position to be known as the Shop Workload Manager.

The system also provides the Shop Workload Manager with a set of management tools for carrying out his responsibilities. Specifically, it suggests preparation of a Shop Personnel Availability Record which would provide him a moving average of the maintenance man-hours available for shop repairs, and Shop Workload Record which would provide him information on the average workload generated and completed daily on the base for each shop. The system would also establish a central file for all "pending workload" which would bring together in one place all known potential backlogs of shop work. It provides policy guidance for activating this work and for maintaining a constant level of active backlog.

The system does not furnish the Shop Workload Manager information on the daily progress (or lack of it) on individual work orders. Neither does it provide him data for evaluating the productivity of specialists or the quality of work accomplished in a shop. In short, the suggestions in this Memorandum are not intended to help the Shop Workload Manager evaluate or direct Shop Supervisors. The productivity of both shops and specialists remains the responsibility of Shop Supervisors and other elements in the chain of command. Thus, efforts of the Shop Workload Manager are directed away from in-shop managerial problems toward scheduling and controlling the gross flow of work through all base repair shops. The proposed system, therefore, is a workload management tool rather than a shop productivity or personnel management tool.